HELITACK

Helispot Location and Construction

by James L. Murphy

FOREST SERVICE—U.S. DEPARTMENT OF AGRICULTURE

PACIFIC SOUTHWEST
FOREST AND RANGE
EXPERIMENT STATION

BERKELEY, CALIFORNIA

MISCELLANEOUS PAPER NO. 31 — APRIL 1959

ACKNOWLEDGMENTS

To J. Whitney Floyd and other personnel of Utah State University, College of Forest, Range, and Wildlife Management, for guidance and help in the preparation of this report under the terms of a cooperative agreement with the Pacific Southwest Forest and Range Experiment Station.

To the following pilots for their technical advice:

Lynn Roberts
Roberts Flying Service
Boise, Idaho

Fred H. Bowen
Southwest Helicopters
Los Angeles, California

Bill Hartley
Cal. Rotors, Inc.
Pasadena, California

Lee Baxter
formerly of International Helicopters
Torrance, California

HELISPOT LOCATION AND CONSTRUCTION

By James L. Murphy

Miscellaneous Paper No. 31

April 1959

U. S. DEPARTMENT OF AGRICULTURE, FOREST SERVICE
PACIFIC SOUTHWEST FOREST AND RANGE EXPERIMENT STATION

CONTENTS

HELISPOT LOCATION AND CONSTRUCTION

By James L. Murphy [1/]

SOME BASIC CONSIDERATIONS

"You cut trees, clear brush, dig out rocks, end up with a cleared area big enough to park a B-25 in—and a puny helicopter can't land in it. What does the pilot want, anyway?"

Unfortunately, a lot of men find themselves in this sort of predicament after working on a helicopter landing area. "What does he want, anyway?" is a good question. "Why does he want it?" is a better question. The answer requires an understanding of how a helicopter flies and what "density altitude" means.

How a Helicopter Flies

Helicopters are called "rotary-winged" aircraft. The overhead rotor does the job of a "fixed" wing on an airplane and also propels the aircraft. The tail rotor counteracts the torque effect of the spinning overhead rotor and stabilizes the aircraft. When a helicopter gets ready to take off, the pilot increases the power until the overhead rotor reaches 3,100 revolutions per minute. This is the power and r.p.m. needed to "lift" the dead weight of the ship. Each half of the blade can be tipped, or, in other words, the pitch of the blades can be changed. The pilot controls the pitch from the "stick" in his left hand. When he increases the pitch, the blades "bite" air, driving it against the ground. Of course, the air escapes from under the blades after it hits the ground, but the rotor is driving more air down than is escaping. As a result, a high density air cushion is built between the rotor blades and the ground.

The helicopter lifts itself up on this dense air cushion. Here, it may hover "in ground effect". To move forward, the pilot pushes the cyclic or joy stick forward, tipping the entire rotor blade path and "pushing" the helicopter toward flight, or thrust. The helicopter drops off the high density air cushion.

1/ Formerly on the staff of the Division of Forest Fire Research, Pacific Southwest Forest and Range Experiment Station; present address: Payette National Forest, Council Ranger District, Council, Idaho.

The work upon which this report is based was performed under terms of a cooperative agreement between Utah State University and the Pacific Southwest Forest and Range Experiment Station, formerly known as the California Forest and Range Experiment Station.

The next few seconds are the critical phase of the helicopter takeoff. It must achieve 18 miles per hour motion, relative to the free air, before the rotor acts as a wing and the helicopter flies. The important thing to remember, particularly when locating the helispots, is that the speed necessary to gain flight, or "translational lift," can be obtained by going forward or down, or both.

Once flying, the pilot maneuvers the helicopter by the two sticks and foot pedals. He synchronizes the two stick controls with the foot pedals controlling the tail rotor and thereby achieves direction.

When the helicopter prepares to land, the power and pitch of the blades are reduced. The "lift" power becomes less than the dead weight of the helicopter. The helicopter drops toward the ground, its direction of flight controlled by the tail rotor acting as a rudder. When the helicopter nears the ground, the pilot searches for his "ground effect," or that altitude at which the rotors start building the dense air cushion. When he finds this point, the pilot tips the helicopter back on its tail, a maneuver called "flaring". The flare allows him to increase the power and blade r.p.m. to a maximum. The helicopter then levels and settles to the ground.

Density Altitude

The rotary-winged helicopter depends upon the density of the air for flight. Everyone knows that as you go up in elevation, the air becomes "thinner," or less dense. Flight is easier and more dependable at sea level than it is at 7,000 feet in the mountains.

Everyone also knows that, as air temperature rises, the air becomes less dense. On a "90-degree in the shade" day, flying might be tough, but on a clear cold, 40-degree day, after a winter storm, flying conditions might be ideal.

So where does all this meteorology and physics fit into building a helispot? Let's take as an example a situation that is familiar to most field men that work with helicopters. A helicopter is operating out of a heliport located in an area you're well acquainted with. You know the elevation of the heliport is 5,000 feet above sea level; the map says so. A new pilot lands at the heliport. He asks the older pilot what the "altitude" is. The reply: "Around 8,000 feet." You step in and correct him. Both pilots then inform you: "5,000 feet is the pressure altitude. But we don't fly by pressure altitudes, we fly by density altitudes." What is density altitude? It is the pressure altitude corrected for the temperature at that moment at that spot. The air is thin enough to begin with at 5,000 feet pressure altitude, but on a 90-degree day the heat makes the air a lot thinner, or less dense.

The helicopter, then, is actually operating in free air that is as thin as you find it at 8, 000 feet, the density altitude. (See Density Altitude Chart in appendix.)

HELIPORT-HELISPOT--WHICH IS WHICH?

Many people are confused by the term heliport and helispot. They seem to be used interchangeably. They are not the same, however,

A heliport is a base of operations for a helicopter; it may be a permanent base of operations called a base heliport or a semipermanent base, called a field heliport. A helispot is any temporary landing spot for helicopters. Helispots usually serve a specific, momentary need such as delivering water to the fireline or rescuing an injured man. A helispot consists of a landing area (the area that must be cleared to safely accommodate the helicopter while on the ground) and the takeoff and landing lanes. The landing area has within it the touchdown pad (that area on which the helicopter rests its skids while on the ground) and the safety area (the clear area outside the touchdown pad necessary for helicopter body and rotor clearance). Now that we've described a helispot, let's concentrate on locating and constructing them.

HELISPOT LOCATION AND CONSTRUCTION BY HAND CREWS

Any helicopter landing area has two basic needs:

1. Adequate takeoff and landing area.
2. Adequate flight paths in and out of the landing area.

Right away the question is raised, "What is meant by 'adequate'?" Let's see if we can be a little more explicit.

Ridge Helispot Locations

1. The best helispots are located on exposed knobs. This type of helispot gives a 360-degree choice of takeoff and landing direction. A landing area on a normal ridge generally gives only two choices of takeoff and landing direction, one side or the other.

2. Always choose a spot where a dropoff is possible for helicopter takeoffs. The higher the elevation, the more important the dropoff becomes. A dropoff gives the helicopter a chance to parlay altitude lost into the necessary flying speed. Remember that if a helicopter has to make a vertical takeoff, it does so on power alone. At higher elevations it may take maximum power to lift vertically. This means that the helicopter can carry only a minimum payload. With a dropoff, the ship may use a lot less power and be able to carry a larger payload.

3. Always locate a helispot so that takeoffs and landings can be made into the prevailing wind. This also becomes more important with higher elevation. For each additional mile per hour of wind between 10 and 30 miles per hour, 15 additional pounds of gross weight may be added to the ship to get the same takeoff performance. A 20 mile per hour wind will allow the helicopter to carry 150 pounds more weight. Exposed knobs on main ridges again offer the best location.

Prevailing winds also help the helicopter gain flying speed. Taking off into a 10 mile per hour wind means that the helicopter must indicate only 8 miles per hour to achieve translational lift. Care must be taken when locating a helispot on a minor lateral ridge or near a bluff. Prevailing winds may be diverted by these features and wind directions may be variable and unpredictable. Under these conditions it is even more important that a wide choice of takeoff and landing direction be available. Caution must be used in locating helispots on lee sides of ridges because of downdrafts and eddies.

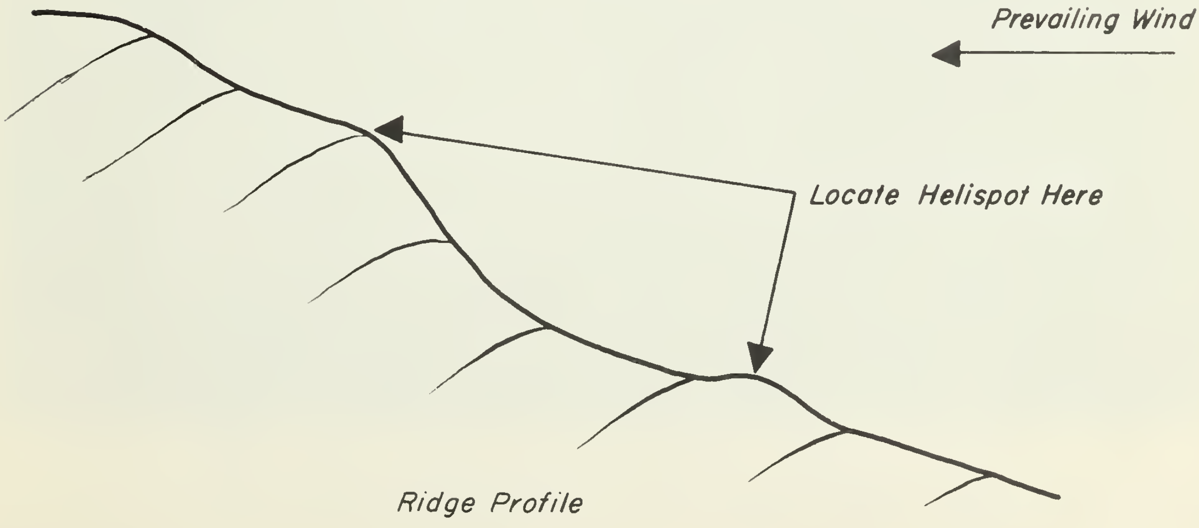
4. Always place a wind indicator on all helispots. Pilots may want to land on the spot when no one is available to indicate direction by other means. Throwing dirt is a good supplement to a wind flag as the dust will give a good indication of the wind velocity and of turbulence. Throwing dirt alone will suffice only if no other means of indicating direction is available.

Locate a helispot on an exposed knob, if possible, with a 360° choice of takeoff and landing direction.

When locating helispots, try to pick natural areas that have a clear approach lane and a dropoff for takeoff into the prevailing wind.

Ridgetop Helispots

---on a Knob



When locating a helispot in timbered country, look for naturally cleared areas offering a minimum resistance to construction.

Ridgetop Helispot Construction

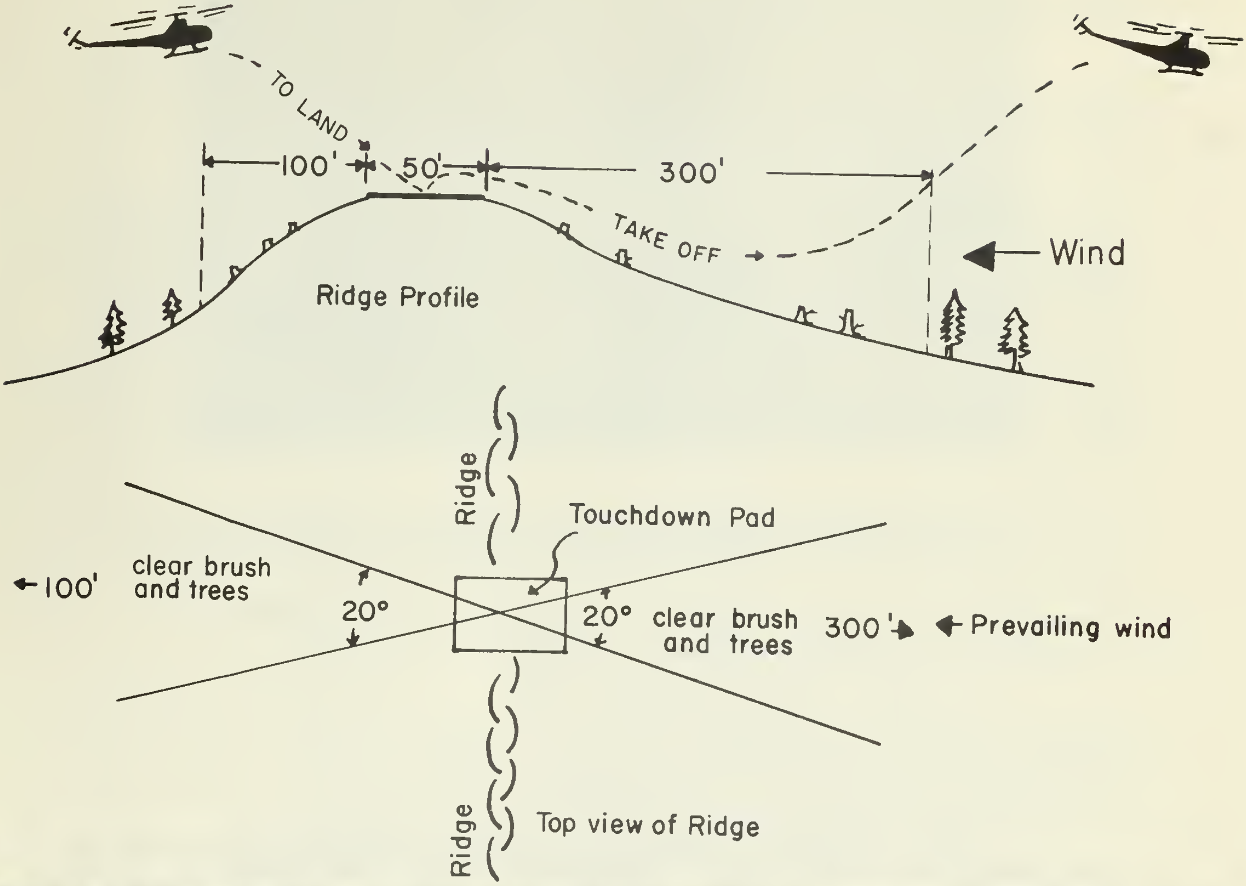
1. Remove all brush and trees within a 50-foot diameter safety circle around the landing area. Most small helicopters have an overall length of 40-42 feet. The diameter of the rotor blades is 35 feet. A 50-foot diameter area will give a good safety margin.

2. Clear brush and trees well below the level of the landing area. The helicopter needs a path to settle into when taking off. At elevations above 5,000 feet, the helicopter may need 200 to 300 feet to lift above the level of the helispot. An exposed knob with a natural dropoff into a dependable prevailing wind again offers the best choice of helispot. If the helispot is on a flat ridgetop or a larger saddle, the brush and trees should be cleared from the takeoff and landing lanes within a 20-degree arc from the landing area.

3. Make the touchdown pad level enough to reduce skid rocking. The pad should slope no more than 10 percent or 2 feet in 20 feet of pad. If the pad is built up with layers of rock and dirt, it must be stable enough to support the 2,400 pounds of a small helicopter. Avoid soft or crusty spots. Most small helicopters have skid dimensions of about 8 x 10 feet. The touchdown pad should be at least 15-20 feet square for safest use. Rocks and branches must be cleared from the pad before the helicopter lands.

RIDGETOP HELISPOTS

---on a Flat Ridge or saddle above 5,000 feet elevation



When constructing a field helispot, clear all brush and trees well below the level of the landing area.

Bottomland Helispots

You hear a lot of men say, "Get that helicopter a hole in the timber just big enough for his rotor to spin without hitting--that's all he needs. He'll just lift right on out."

Nothing could be further from the truth. There may be a very few cases, at sea level perhaps or in the teeth of a strong prevailing wind, where the helicopter might safely lift straight up out of a hole. But most helicopters on forestry jobs often operate at elevations above 5,000 feet. The importance of a dropoff during takeoff under these conditions has already been discussed. If a helicopter can't lift out of a 40-foot hole in the timber or brush, where can you put a helispot in flat country that is timbered or brush-covered--or in a canyon?

Generally, helispots are located and constructed in the following bottomland situations:

1. A "hole" in a continuous flat-country stand of timber or brush.
2. By a lake or wide stream.
3. In a canyon bottom.
4. In a meadow.
5. In a road or truck trail.

Some general statements may be made about locating and constructing bottomland helispots in these situations:

1. A truly vertical takeoff should not be considered safe at any elevation. Remember that the small helicopter must be at least 300 feet above the ground in order to auto-rotate or "glide" back to the ground in the event of engine failure. If the ship is less than 300 feet above the ground, it will drop like a rock. (See "The Deadman's Curve," in appendix.)

2. A vertical takeoff should never be depended upon under any circumstances when the helicopter is operating above 5,000 feet elevation.

3. Be sure the takeoff path is into the prevailing wind. Avoid "dead air" spots such as deep holes or areas on lee sides of ridges.

4. The best and safest takeoff path in a bottomland situation would be 300 feet long, slightly downhill with a good line of sight. The helicopter should be flying by the time he travels this distance.

5. Be sure the helicopter has some place to go when he gains forward flight at the end of this 300 foot takeoff path.

A good timber country helispot. It has a clear drop-off into the prevailing wind, and the timber is cleared within a 50-foot area on the helispot.

a. Can he continue "on and up" from his takeoff path, clearing all obstacles, such as trees, or ridges safely?

b. Will he have to circle, or "screw out" of the helispot to gain altitude with which to leave the area? If so, he will need a turning radius of 100 to 150 feet of cleared area within which to circle.

Here are some specific hints about locating helispots in four bottomland situations:

<u>Lakes or wide streams</u>.--Water furnishes a good ground-effect base. Remember that the helicopter will need at least 300 feet of water over which to gain flying speed. Also the ship will need a safe touchdown pad on the shore from which to operate.

<u>Canyon bottoms</u>.--Beware of "dead-air" holes. Be sure the canyon does not have a downdraft from one of the neighboring ridges. If the canyon is deep, the helicopter will need a long forward run to pull out of the canyon or an extra wide spot in the canyon within which he can circle safely.

<u>Meadows</u>.--Beware of meadows with high grass. The grass will tend to dissipate helicopter ground cushions. High grass may also hide rocks, logs, or swampy areas.

<u>Roads or truck trails</u>.--Try to pick turnouts or parking areas that might have some dropoff. If there are no dropoff areas available, be sure the helicopter has plenty of takeoff distance available down the road. Stay clear of heavily used roads or truck trails unless in an emergency, or unless traffic control has been previously arranged.

USING TRACTORS IN HELISPOT CONSTRUCTION

Many helispots may be constructed by tractors on fires or on timber sale contract projects. The fundamental requirements of field helispots are about the same whether constructed by hand crews or tractors, but a few added precautions need to be remembered when landing areas are constructed by tractors:

1. Tractors often work near developed areas. Power lines and telephone lines may be present. Remember that pilots ordinarily can only see the poles--they rarely can see the lines. Avoid this situation.

2. Tractors may dislodge large rocks. These must be removed and the area smoothed before the helicopter can land.

3. Occasionally a tractor can construct an excellent helispot but is unable to remove tall brush and trees on the adjacent slopes. Hand crews must work with the tractor to remove the growth before the helicopter lands.

4. Tractor work tears up the soil in such a manner that dust and flying pebbles constitute a menace to both the pilot and the helicopter engine during takeoffs and landings. The eyes of any nearby person may be endangered also. If the helispot is to be used soon after construction and before the winter's rain, arrangements should be made to dustproof the area by wetting down, or, if possible, by oiling.

Dustproof all helispots, if possible, by watering down or other method. The dust may injure the eyes of personnel or cause damage to the helicopter.

HELICOPTER LANDING APPROACHES

Most of the discussion thus far has been about helicopter takeoffs. But what about helicopter landing approach paths? Generally the landing is nowhere near as critical as the takeoff. The helicopter already has his altitude and/or flying speed. He will not have to drop below the level of the helispot in landing. However, a truly vertical landing cannot be depended upon under normal conditions. Therefore, an approach path free of obstructions will be necessary.

If the helispot is on a point or a knob, clear any trees or brush that project above the level of the landing area. The clearing will allow the helicopter to make a safe "flare out" landing.

If the helispot is on a flat ridgetop or in a saddle, clear brush and trees within a 20-degree arc from the landing area. Remember that the helicopter lands into the prevailing wind.

If you are near a possible landing area and see a helicopter circling above you, the chances are he may want to land. Always give him the wind direction:

1. Place white, yellow or orange flagging on an exposed, visible spot. Don't place a high pole in his landing or takeoff lane.

2. Throw dirt--a lot, and high.

3. Stand with your back to the wind, both arms extended in front of you, pointing with the wind and indicating to the pilot, "Land here."

At bottomland helispots the question may arise: "Where does the approach path end and the takeoff path begin? If the helicopter needs 300 feet of clear takeoff area, do I have to add another 100 feet for clear landing area also?" Generally, the 300 feet will be plenty. The helicopter may land into the prevailing wind near the end of the takeoff path. However, when the pilot gets ready to take off, he can hop the empty ship back to the beginning of the takeoff lane, load it, and use the entire 300 feet to gain flying speed. Extra clearance for landing paths, then, is not usually necessary.

Provide a permanent wind flag if possible. Use a smooth bark pole or remove the bark so that the flag will not hang up.

Stand with your back to the wind. Extend your arms toward the helicopter indicating "land here".

Throw dirt--a lot, and high. Dust will help to tell the pilot the wind velocity and to warn him of turbulence.

HELISPOT MARKING

Many men spend a lot of man hours constructing a helispot, particularly in timbered country, only to find that it is difficult--often impossible--to find again. All helispots should be marked so that they are readily visible from the air. An old tire, painted yellow and anchored securely, makes a good marker. A galvanized metal triangle may be fastened over the tire to make it more visible. A large identification number may then be painted on the triangle. Four rocks, or stumps, each located near one corner of the landing area, may be sprayed with orange or yellow paint to delineate the area.

Field experience indicates that recreationists may disturb the tire locations unless they are labeled as government property. Anchoring the tires firmly will also discourage their removal. Where the helispot is likely to be used often, a cement slab may be justified in lieu of the less permanent tires.

Old tires painted high visibility yellow or orange, help to make the landing area visible from the air.

HELISPOT MAPPING AND RECORDING

No two helispots will have the same conditions or topography, adjacent cover, wind, or associated hazards. For purpose of future reference, field men have found that helispot recording, both by description and on a map, helps to orient pilots intending to land on the helispots.

Field recording. --All helispots should be recorded on some type of helispot information form. (See suggested helispot information form in appendix.) The forms should be filled out at the helispot after it is finished and before leaving the area. Supply all the information you can, especially hazard information.

Office filing. --Three active helispot files should be maintained:

1. Currently usable helispots approved by the pilot.

2. Completed helispots requiring maintenance to become safe or currently usable.

3. Planned helispot locations, to be constructed.

> Important: If a helispot becomes unsafe to use because of needed maintenance or other reasons, remove that helispot record from the currently usable file.

Helispot mapping. --When a fire or other project requiring a helicopter occurs, the project is usually located on a map. If available helispots are marked on that map, the possibilities of immediate helicopter service can readily be seen. Colored circles may obscure map detail and may be difficult to remove if a helispot becomes unsafe. Numbered map pins have been found very satisfactory for this purpose. The heads stand off the map, leaving all detail visible, and they are readily removed. The helispot may be identically numbered in the field, in the description files, and on the map, for ready reference.

IF IN DOUBT, ASK THE PILOT

It is difficult to write about locating and constructing helispots. Every helispot is located and constructed under different conditions. To list a set of instructions covering all conditions is impossible. It is hoped that the basic fundamentals along with the few general observations presented here will help the beginner. Maybe the most helpful suggestion, after all, might be simply: "If in doubt, ask the pilot!"

APPENDIX

HELISPOT LOCATION, CONSTRUCTION CHECKLIST

Important: Use this checklist twice.

1. Before you begin work on helispot
2. After you think you have finished construction of helispot.

BEFORE-AFTER CONSTRUCTION

- [ ] Can takeoffs and landings be made into the prevailing wind?
- [ ] Are takeoff and landing lanes cleared well below level of landing pad?
- [ ] If helispot is on a ridge or knob, has helispot a clear drop-off for takeoff?
- [ ] Is helispot landing area at least 50 feet in diameter for rotor clearance?
- [ ] Is touchdown pad at least 15 feet square?
- [ ] Is touchdown pad level and firm?
- [ ] Is touchdown pad clear of rocks, brush and stumps?

IF HELISPOT IS IN A MEADOW; BY A LAKE; ON FLAT GROUND

- [ ] Has helicopter at least 300 feet of clear area to achieve forward flight?
- [ ] Is area at least 250 feet wide so that helicopter can circle or "screw" out?

BEFORE LEAVING HELISPOT

- [ ] Have you placed a wind indicator on helispot?
- [ ] Have you marked helispot so it is visible from air?
- [ ] Have you filled out Helispot Information Form completely?

HELISPOT INFORMATION FORM

Helispot Number_______________Elevation_______________

Location: 1/4 Sec. ______Section______T. _______R. ______

Location by landmark_________________________________

Topography:	Point	/_/	Adjacent cover type:	
	Knob	/_/	Timber	/_/
	Ridge	/_/	Brush	/_/
	Saddle	/_/	Grass	/_/
	Meadow	/_/	Barren	/_/
	Flat	/_/		

Prevailing wind direction______________________________

Most reliable approach direction_______________________

Most reliable takeoff direction________________________

Density altitude, average summer afternoon____________

Hazards (describe): __________________________________

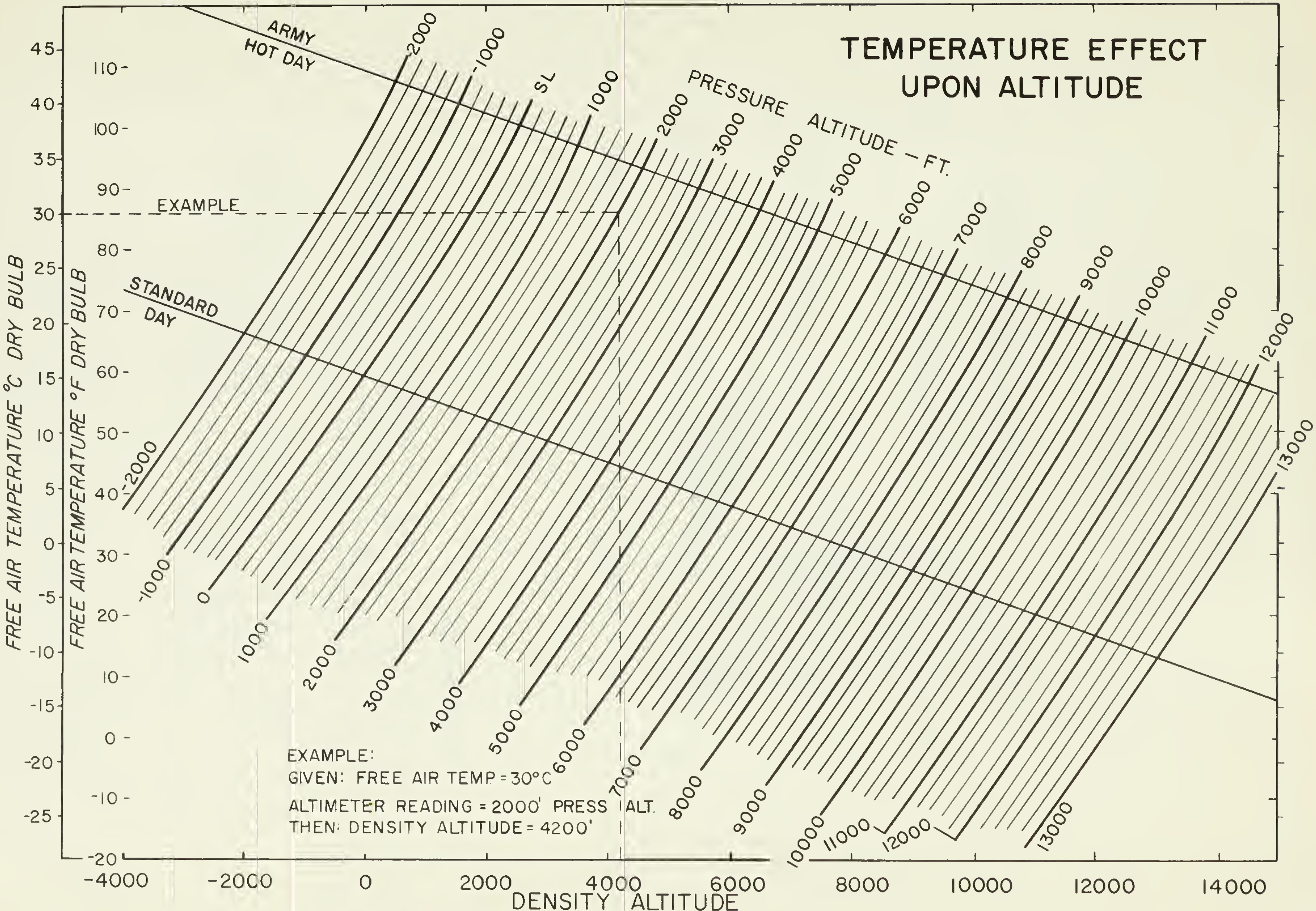
____

____

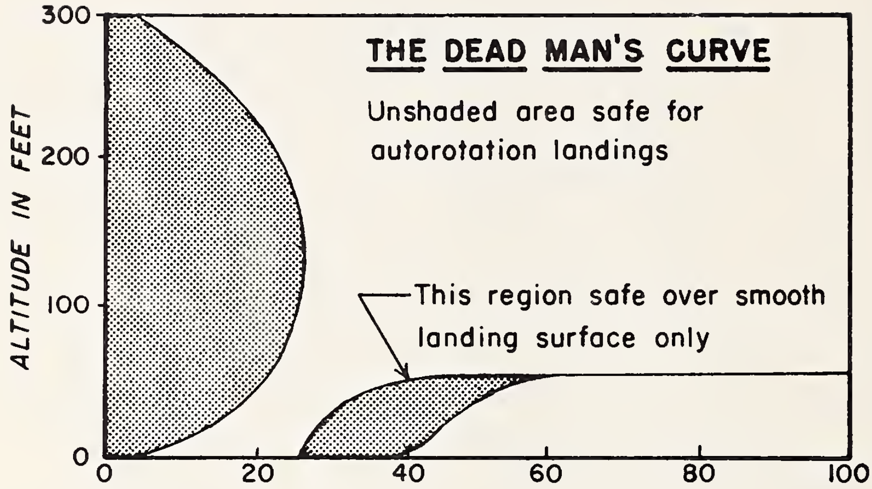
Remarks:____

____

____


TEMPERATURE EFFECT UPON ALTITUDE
PRESSURE ALTITUDE – FT.
ARMY HOT DAY
STANDARD DAY
EXAMPLE
-2000
-1000
SL
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
10000
11000
12000
13000
FREE AIR TEMPERATURE °C DRY BULB
FREE AIR TEMPERATURE °F DRY BULB
DENSITY ALTITUDE
-4000
-2000
0
2000
4000
6000
8000
10000
12000
14000
45
40
35
30
25
20
15
10
5
0
-5
-10
-15
-20
-25
110
100
90
80
70
60
50
40
30
20
10
0
-10
-20
EXAMPLE:
GIVEN: FREE AIR TEMP. = 30°C
ALTIMETER READING = 2000' PRESS ALT.
THEN: DENSITY ALTITUDE = 4200'

THE "DEADMAN'S" CURVE *



* Reprinted from Bell Helicopter Flight Manual for Bell Model 47 G2.

REMEMBER:

1. The helicopter must lift vertically at least 300 feet before it can safely autorotate. If the engine fails before reaching 300 feet, the ship will drop like a rock.

2. If the helicopter is flying at an altitude of less than 200 feet and the engine fails, the ship must have a forward speed of at least 28 miles per hour to autorotate safely to the ground or it drops like a rock.

U. S. DEPARTMENT OF AGRICULTURE
FOREST SERVICE
PACIFIC SOUTHWEST
FOREST AND RANGE EXPERIMENT STATION
POST OFFICE BOX 245
BERKELEY 1, CALIFORNIA

OFFICIAL BUSINESS

POSTAGE AND FEES PAID
U. S. DEPARTMENT OF AGRICULTURE